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## SECTION 02100

## DIVERSION AND CONTROL OF WATER

## PART 1 GENERAL

## 1.1 REQUIREMENT

## 1.1.1 General

All permanent construction shall be carried on in areas free from water. Storm runoff from watersheds can be rapid and, during periods of rain, flash flooding may be expected. The project consists of improvements to a natural drainage course downstream of a detention basin and may be subject to a prolonged flow after a major rainfall event. The 100-year event discharge from the detention basin is 5.1 cubic meters per second.

Within 10 days after receipt of Notice to Proceed, the Contractor shall submit a control of water plan showing the method that he proposes to use to protect each working area. The responsibility for damage to any part of the permanent work shall be as set forth in the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. Damage to all work (including temporary construction), utilities, materials, equipment, and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

## 1.1.2 Requirements

The Contractor is responsible for control of all runoff entering the construction area. The runoff will include water originating from upstream drainages; and in addition any and all seepage and groundwater originating within the work. The work site may be inundated because of runoff. The Contractor shall be responsible for protection of work site during times of runoff by his own means as described in his SWPPP as required per Section 01200 GENERAL REQUIREMENTS and shall be approved by the Contracting Officer.

## 1.1.3 Drainage Ditches

The location and depth of any drainage ditch to be constructed under this contract shall be subject to the approval of the Contracting Officer. Special precautions shall be taken to avoid impairing the permanent subgrade. Damaged subgrade shall be replaced in accordance with Section 02250 FILLS AND SUBGRADE PREPARATION by and at the expense of the Contractor.

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## SECTION 02150

## CLEAR SITE AND REMOVE OBSTRUCTIONS

## PART 1 GENERAL

## 1.1 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Sections 01130 ENVIRONMENTAL PROTECTION and 02200 EXCAVATION.

## 1.2 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 REQUIREMENTS

## 3.1.1 General

Except as otherwise specified, and/or indicated, areas to be cleared will be limited to actual excavation areas, and areas on which fills and/or structures are to be placed. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, turf, or vegetation which can be left in place.

## 3.1.2 Existing Structures and Obstructions

The Contractor shall clear and grub, fill and excavation areas, and remove and dispose of existing structures and obstructions necessary for project construction, except for those structures which are identified to be protected in place as shown on the drawings. Obstructions which are designed or specified to be removed but which are not designated or specified to be removed by others shall be removed by the Contractor. Except as otherwise specified, obstructions designated to be removed by others will be removed in sufficient time to preclude interference with the Contractor's operations.

## 3.1.3 Clearing

Trees smaller than 38 millimeters in diameter and other vegetation, except as specified, shall be cut off 0.15 meters below the indicated subgrade or ground level whichever is lower. Grasses, shrubs and weeds shall be cut off flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures,

and installations under construction, or to remain in place, and to provide for the safety of employees and others. All rubbish, waste dumps, and debris areas shall be cleared.

#### 3.1.4 Grubbing

Grubbing shall consist of removing all trees, stumps, roots, logs, and other objectionable vegetable matter in the required fills, foundation areas, and all excavation areas. In grubbing out stumps and roots, all roots or other timber more than 38 millimeters in diameter shall be removed to 1 meter below the depth of the required excavation or existing ground level, whichever is lower. Trees and stumps shall be pulled, not cut off.

#### 3.1.5 Trash and Construction Debris

Surface trash and construction debris may be present at the project site. Surface trash and construction debris shall be removed from within the limits of the right-of-way and temporary construction easements.

#### 3.1.6 Environmental Assessment Requirement

The Contractor shall notify the Contracting Officer 14 Calendar days prior to the start of clearing and grubbing activities in accordance with Section 01200 GENERAL REQUIREMENTS.

### 3.2 DISPOSAL OF CLEARED, GRUBBED, AND REMOVED MATERIAL

All material removed, except material specified and/or indicated to be salvaged, is designated as scrap, shall become the property of the Contractor, and shall be removed from the site. Disposal shall be in accordance with the requirements of Section 01130 ENVIRONMENTAL PROTECTION.

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## SECTION 02200

## EXCAVATION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
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## ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual
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## 1.2 GENERAL

Excavation shall consist of the removal of every type of material encountered in the designated areas or from areas directed. The material to be removed may include but is not limited to hardpan, silt, sand, gravel, cobbles and boulders, cemented silt/sand/gravel/cobbles/boulders with various degrees of cementation, caliche, asphalt, vegetation, trash, and other debris. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Measurement for payment shall be in accordance with Section 01251 MEASUREMENT AND PAYMENT. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation may require ripping or other rock-excavation techniques and shall be performed in a manner which will not impair the subgrade. Rock or cemented material from required excavation to be used in compacted fills and backfills shall be crushed or otherwise reduced in size to meet gradation requirements contained in Section 02250 FILLS AND SUBGRADE PREPARATION prior to placement or stockpiling. Except as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 12.5 millimeters from indicated grade. Prior to commencing excavation, the Contractor shall submit his plan for excavation to the Contracting Officer.

All subgrade excavations will be inspected by the Contracting Officer prior to placement of any fill materials.

## 1.3 BLASTING

Blasting will not be permitted.



#### 1.4 PRESERVATION OF PROPERTY

All excavation operations shall be conducted in such a manner that concrete structures, embankments, utilities, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such improvements or to support the improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval shop drawings showing proposed method of bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressures exerted by (and the condition and nature of) the materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such manner as not to disturb or damage the finished concrete or other facility.

#### 1.5 EXCAVATION ADJACENT TO STRUCTURES

Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with EM 385-1-1.

#### 1.6 EXCAVATION CHANNEL

Channel excavation consists of the removal of all materials within the lines and grades indicated.

#### 1.7 REMOVAL OF UNSATISFACTORY SOILS

The removal of soils which are unsatisfactory for foundation of channel, or structures may be required in certain areas. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487, as Pt, OH, OL, CH, MH, and materials that are too wet to support construction equipment. The Contractor will be required to excavate any such areas to the depth directed and backfill the areas with compacted fill conforming to the requirements of the Section 02250 FILLS AND SUBGRADE PREPARATION.

#### 1.8 EXCAVATED MATERIALS

Excavated materials suitable for required fills shall be placed in temporary stock piles or used directly in the work. The Bureau of Land Management and the Howard Hughes Corporation maintain the mineral rights to the materials on their properties. Excavated materials from each property shall be stockpiled or placed on the property from which it was excavated. No excavated material or waste of any kind shall be disposed of at any

place beyond the limits of the work under this contract without the expressed authority of the Contracting Officer. Prior to placing material, the miscellaneous fill and any approved stockpile area(s) shall be cleared of trash and vegetation. Vegetation shall be cut off at the existing ground line. Clearing shall conform to the applicable requirements of Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS. Any stockpiles shall be placed in a manner to preclude ponding of water.

#### 1.9 OVERCUT

Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to the Section 02250 FILLS AND SUBGRADE PREPARATION, or concrete conforming to the Section 03307 CONCRETE FOR MINOR STRUCTURES. All excavating, backfilling, compacting of backfill, and concreting occasioned thereby shall be by the Contractor at no additional cost to the Government. Any overcut under channel and structures shall be backfilled with concrete.

#### 1.10 EXCAVATION AT TURNAROUND AREA

Excavation required to complete rough grade at the turnaround area should be anticipated to be difficult. The highly cemented native material shall require hoe ramming, rock saw, or other rock removal techniques without the use of explosives.

#### 1.11 SOIL STABILIZER

Finished grades in areas of cut shall be treated with a soil stabilizer in accordance with Section 02250 FILLS AND SUBGRADE PREPARATION.

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## SECTION 02220

## DEMOLITION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

## 1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

#### 1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

#### 1.5 PROTECTION

##### 1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.

##### 1.5.2 Protection of Structures

The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

##### 1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

##### 1.5.4 Protection From the Weather

Salvageable materials and equipment shall be protected from the weather at all times.

##### 1.5.5 Environmental Protection

The work shall comply with the requirements of Section 01130 ENVIRONMENTAL PROTECTION.

#### 1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

## 1.6 USE OF EXPLOSIVES

Use of explosives will not be permitted.

## 1.7 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available for the entire duration of the contract.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed, in their entirety, to the subbase elevation.

### 3.2 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

#### 3.2.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

##### 3.2.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

#### 3.2.2 Unsalvageable Material

Concrete, masonry, and all other unsalvageable material, shall be disposed of in a facility off site by the Contractor.

### 3.3 CLEAN UP

Debris and rubbish shall be removed from excavations and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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## SECTION 02241

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## SECTION 02241

## AGGREGATE BASE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2217	(1985; R 1998) Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D 2844	(1989) Resistance R-Value and Expansion

## Pressure of Compacted Soils

ASTM D 4318 (1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing Purposes

## 1.2 DEFINITIONS

## 1.2.1 Aggregate Base

Aggregate base as used herein is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

## 1.2.2 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. The field dry density shall be determined by ASTM D 1556. The laboratory maximum density shall be determined by ASTM D 1557 Method B or D.

## 1.2.3 Moisture Content

Moisture content is the ratio of the weight of the water to the weight of the solid matter expressed as a percent and it is determined by ASTM D 2216.

## 1.3 GENERAL

The work specified herein consists of the construction of an aggregate base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-18 Records

Coarse Aggregate; GA.

A notification stating which type of coarse aggregate is to be used.

Waybills and Delivery Tickets; GA.

Copies of waybills and delivery tickets during the progress of the work. Before the final payment is allowed, the Contractor shall file certified waybills and delivery tickets for all materials actually used.

## SD-01 Data

Plant, Equipment, Machines, and Tools; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

## SD-09 Reports

Sampling and Testing; GA.

Field Density; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated.

Copies of field test results within 24 hours after the tests are performed.

Certified copies of test results for approval not less than 30 days before material is required for the work.

## 1.5 WAYBILLS AND DELIVERY TICKETS

Copies of waybills and delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, waybills and certified delivery tickets shall be furnished for all aggregates actually used in the construction.

## 1.6 WEATHER LIMITATIONS

Base shall not be constructed when the atmospheric temperature is less than 2 degrees C. Base shall not be constructed on subgrades that are frozen or contain frost. If the temperature falls below 2 degrees C, completed areas shall be protected against any detrimental effects of freezing.

## 1.7 PLANT, EQUIPMENT, MACHINES, AND TOOLS

## 1.7.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. The equipment shall be adequate and have the capability of producing the results specified.

## 1.7.2 Steel-Wheeled Rollers

Steel-wheeled rollers shall be the self-propelled type weighing not less than 9 metric tons, with a minimum weight of 135 kilograms per millimeter width of rear wheel. Wheels of the rollers shall be equipped with adjustable scrapers. The use of vibratory rollers is optional.

## 1.7.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have four or more tires, each loaded to a minimum of 13,600 kilograms and inflated to a minimum pressure of 1035 kPa.

The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Towing equipment shall also be pneumatic-tired.

#### 1.7.4 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

#### 1.7.5 Tamers

Tamers shall be of an approved mechanical type, operated by either pneumatic pressure or internal combustion, and shall have sufficient weight and striking power to produce the compaction required.

#### 1.7.6 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 3.66 meter straightedge, for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on all surfaces.

### 1.8 STOCKPILING MATERIALS

Materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at locations designated. Before stockpiling of material, storage sites shall be cleared, and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

### 1.9 SAMPLING AND TESTING

#### 1.9.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the locations and times directed to insure that materials and compaction meet specified requirements. Copies of test results shall be furnished to the Contracting Officer for approval 7 days prior to starting work and thereafter at regular interval during production as specified hereinafter.

### 1.9.2 Test Results

Results shall verify that materials comply with this specification. When a material source is changed, the new material will be tested for compliance.

When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer.

### 1.9.3 Sampling

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75.

### 1.9.4 Sieve Analysis

Before starting work, at least one sample of material shall be tested in accordance with ASTM C 136 and ASTM D 422 on sieves conforming to ASTM E 11.

After the initial test, a minimum of one analysis shall be performed for each 1000 metric tons of material placed, with a minimum of one analysis for each day's run until the course is completed.

### 1.9.5 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318, Method A on samples prepared in accordance with ASTM D 2217.

### 1.9.6 Laboratory Density

Tests shall provide a moisture-density relationship for the aggregate. Tests shall be conducted in accordance with ASTM D 1557, Method B or D.

### 1.9.7 Wear Tests

Wear tests shall be performed in accordance with ASTM C 131. One test shall be run per 1000 square meters of completed base course. A minimum of one test per aggregate source shall be run.

## PART 2 PRODUCTS

### 2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of gravel, stone, crushed stone, crushed gravel, angular sand, or other approved material. Aggregates shall be free from lumps of clay, organic matter, objectionable coatings, and other foreign material. Material retained on a 4.75 mm sieve shall be known as coarse aggregate and that passing the 4.75 mm sieve shall be known as binder material.

#### 2.1.1 Coarse Aggregate

Only one type of coarse aggregate shall be used on the project. Coarse aggregates, consisting of angular fragments of uniform density and quality,

shall have a percentage of wear not to exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3.

#### 2.1.2 Binder Material

Binder material shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 29 and a plasticity index not greater than 5.

#### 2.1.3 Gradation Requirements

Requirements for gradation specified shall apply to the completed base course. The aggregates shall have a 25 millimeter maximum size and shall be continuously graded within the following limits, when tested in accordance with the requirements of ASTM C 136:

Sieve Designation	Percentage by Weight Passing Square-mesh Sieve
25 mm	100
19.0 mm	90-100
4.75 mm	35-65
1.18 mm	15-40
0.075 mm	2-10

The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction in accordance with ASTM C 127 and ASTM C 128 when aggregates of varying specific gravities are used.

#### 2.1.4 Physical Properties

Minimum R-Value when determined in accordance with ASTM D 2844 shall be 78 percent. The percentage fractured faces, when determined in accordance with STATE OF NEVADA DEPARTMENT OF TRANSPORTATION MATERIALS TESTING DIVISION (NDOT) NDOT T 230 (Rev C) "Method of Test for Determining the Percent of Fractured Faces" shall be 50 percent.

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be

provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

### 3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from off-site sources.

### 3.3 PREPARATION OF UNDERLYING COURSE

#### 3.3.1 General Requirements

Before constructing aggregate base course, the previously constructed underlying course shall be cleaned of foreign substances. Surface of underlying course shall meet the specified compaction and surface tolerances. Subgrade shall conform to Section 02250 FILLS AND SUBGRADE PREPARATION. Ruts or soft, yielding spots that may appear in the underlying course, areas having inadequate compaction, and deviations of the surface from requirements specified shall be corrected. For cohesionless underlying materials containing sands, sandy gravels, or any other cohesionless material in harmful quantities, the surface shall be mechanically stabilized with aggregate prior to placement of the aggregate course. Stabilization may be accomplished by mixing base course material into the underlying course and compacting by approved methods. Properly compacted material will be considered as part of the underlying course and shall meet all requirements for the underlying course. Preparation of the underlying course shall include scarification of materials to a minimum depth of 150 mm and compaction to 95 percent maximum density in accordance with the requirements of Section 02250 FILLS AND SUBGRADE PREPARATION. Finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until base course is placed.

#### 3.3.2 Grade Control

Underlying material shall be excavated to sufficient depth for the required base course thickness so that the finished base course with the subsequent surface course will meet the design grade. Finished and completed area shall conform to the lines, grades, cross section, and dimensions indicated.

### 3.4 INSTALLATION

#### 3.4.1 Mixing and Placing

Materials shall be mixed by the stationary plant, traveling plant, or road mix method and placed in such a manner as to obtain uniformity of the aggregate base course material and at a uniform optimum water content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to ensure a satisfactory base course.

#### 3.4.2 Edges of Base Course

Approved material shall be placed along edges of aggregate base course in such quantities as will compact to thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 300 mm width of the shoulder to be rolled and compacted simultaneously with rolling and compacting of each layer of base course.

#### 3.4.3 Compaction

Each layer of aggregate base course including shoulders shall be compacted.

Water content shall be maintained at optimum. Density of compacted mixture shall be at least 100 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths.

Speed of the roller shall be such that displacement of the aggregate does not occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.

#### 3.4.4 Layer Thickness

Compacted thickness of the aggregate course shall be as indicated on the drawings. No layer shall be in excess of 200 mm nor less than 75 mm in compacted thickness.

#### 3.4.5 Finishing

The surface of the top layer shall be finished to grade and in accordance with the cross section shown in the drawings. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

#### 3.4.6 Smoothness

Surface of each layer shall show no deviations in excess of 9.5 mm when tested with the 3.66 meter straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

#### 3.4.7 Thickness Control

Compacted thickness of the base course shall be within 12.7 mm of the thickness indicated on the drawings. Where the measured thickness is more than 12.7 mm deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 12.7 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 7 mm of the thickness



indicated.

### 3.5 FIELD QUALITY CONTROL

#### 3.5.1 Field Density

Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. At least one field density test shall be performed for each 250 square meters of each layer of base material.

#### 3.5.2 Smoothness

Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 3 meter straightedge. Measurements shall also be taken perpendicular to the road centerline at 25 meter intervals.

#### 3.5.3 Thickness

Thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

### 3.6 TRAFFIC

Completed portions of the area may be opened to traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary for construction, and then the area shall be protected against marring or damage to the completed work.

### 3.7 MAINTENANCE

The aggregate base course shall be maintained in a satisfactory condition until accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

In-place materials, that are unsatisfactory for the base course material that are removed for the required correction of defective areas, waste material, and debris, shall be disposed of as directed at no additional cost to the Government. Unsatisfactory materials shall be defined per Section 02200 EXCAVATION.

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## SECTION 02250

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## SECTION 02250

## FILLS AND SUBGRADE PREPARATION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09, Reports

Testing of Compacted Fill Materials; GA.

Field Density Tests; GA.

Copies of all laboratory and field test reports within 24 hours of the completion of the tests.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION (NOT APPLICABLE)

## 3.1 COMPACTION EQUIPMENT

Compaction shall be accomplished by tamping roller, rubber tired roller vibratory compactor or mechanical tampers. All equipment, tools, and machines shall be maintained in satisfactory working condition at all times. Compaction equipment shall be suitable for consistently producing uniform soil densities.

## 3.2 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS

## 3.2.1 Control

Moisture-density relations shall be established by the Contractor. The soil used for each maximum density test shall be classified in accordance with ASTM D 2487 and shall include a particle size analysis in accordance with ASTM D 422. At least one five point maximum density test shall be made for every 10 field density tests. Field density tests shall be performed by the Contractor at the frequency established in paragraph: 1.4.1.2 Field Control, and in such locations to insure that the specified density is being obtained. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight determinations shall be provided on the day each test is taken. The completed test reports shall be provided with the Contractor Quality Control Report on the work day following the test.

## 3.2.2 Laboratory Control

Moisture-density relations shall be established by the Contractor. One moisture-density relation shall be made for each classification, blend or change in classification of soil materials encountered. Approval of moisture-density relations shall be obtained prior to the compacting of any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557.

- a. The desired amount of mixing water will be added for each compaction test specimen, mixed well, and the mixture will be placed in a container with an airtight cover and allowed to cure for 24 hours. A shorter curing time may be allowed where tests show that shortening the curing time will not affect the results.

## 3.2.3 Field Control

Field in-place density shall be determined in accordance with ASTM D 1556. The field moisture content shall be determined in accordance with ASTM D 2216. Determination of in-place densities using the nuclear method ASTM D 2922 may be used to supplement the sand cone density tests ASTM D 1556. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. At least one adjacent sand cone test shall be performed for every five nuclear density tests performed. If field density tests determined by the nuclear method vary by more than 0.5 kilonewtons per cubic meter from comparison

sand-cone tests, and are consistently high or low, adjustment of the calibration curve is necessary.

a. In-Place Densities

(1) A minimum of one test per 500 cubic meters of fill or backfill for areas compacted by other than hand-operated machines. At least one test shall be made in each 0.6 meter layer of compacted fill or backfill processed as a unit and not less than one test shall be made in each area.

(2) One test per 200 cubic meters, or fraction thereof, shall be made of each lift of fill or backfill areas compacted by hand-operated machines.

The Contractor CQC shall maintain a log of all tests which will be updated and submitted to the Contracting Officer on a weekly basis. The test log shall include: Test number (if retest shall include retest number), date, feature of work, station and offset, weight of wet soil, weight of dry soil, percent of compaction, optimum moisture content, maximum dry unit weight, soil classification, in-place density test methods either sand-cone or nuclear densimeter.

Settling of fills or backfills with water will not be permitted.

3.2.4 Fill Material

Fill material shall be obtained from the required excavation or borrow area shown on the plans. Materials considered unsatisfactory for use as compacted fill include but are not limited to those materials containing roots and other organic matter, trash, and debris. Chunks or clumps of cemented material shall be crushed and processed to contain no stone whose greatest dimension is more than 3/4 the lift thickness. Larger size stone, crushed materials, and concentrated chunks, shall be mixed with a binder for compaction. The Contractor shall expect to break-down, crush or otherwise process required excavation for use as fill material due to the cementation of in-situ soils. Materials classified in ASTM D 2487 as MH, CH, Pt, OH, and OL are also considered unsatisfactory for use as compacted fill. Material for compacted fill behind concrete structures shall contain less than 30 percent by weight passing the No. 200 sieve and shall contain no stone larger than 75 mm.

3.2.5 Placement

Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 17.2 megapascals when tested in accordance with Section 03307 CONCRETE FOR MINOR STRUCTURES. Placement over pipes and buried structures shall be in accordance with Section 02400 REINFORCED CONCRETE PIPE. Compacted fill shall be placed with suitable equipment in horizontal layers which before compaction, shall not exceed 300 mm in depth for rubber-tired or vibratory rollers, 200 mm in depth for tamping rollers, and 100 mm in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing

stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids. All fill areas not receiving additional treatment, such as concrete or aggregate base course, shall be final graded to the lines and grades shown on the drawings with a completed tolerance of +/- 25 mm in 3.65 meters.

#### 3.2.6 Moisture Content

Material shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 2 percent above optimum and a minimum moisture content of not less than 2 percent below optimum.

#### 3.2.7 Compaction

No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to operate within 0.3 meters of structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of 600 mm. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures where rolling equipment is impracticable for use in compaction.

### 3.3 COMPACTED FILL

#### 3.3.1 Preparation for Placing

Before placing material for compacted fill, the foundation surface shall be cleared of all existing obstructions, vegetation and debris. Unsatisfactory or unstable (too wet) material not meeting the requirements for fill material shall be removed where directed. The existing surfaces for the compacted fill shall be proofrolled by four passes of the compaction equipment and scarified to a depth of 150 millimeters. Sloped ground surfaces steeper than one vertical to 4 horizontal, on which fill or compacted fill is to be placed, shall be stepped in such a manner that the equipment will bear on the full depth of the fill layer.

#### 3.3.2 Compacted Fill, Pipe

##### 3.3.2.1 Compaction

Compacted fill includes fill under and adjacent to the channel and under the maintenance road more than 300 mm beneath the road base course. Compacted Fill, Pipe includes fill more than 610 mm above the top of pipe. Each layer of the material shall be compacted to not less than 90 percent of maximum density, per ASTM D 1557.

### 3.3.2.2 Trimming

The side slopes of the channel shall be trimmed to the lines indicated on the drawings with a tolerance of plus or minus 25 millimeters. Any material loosened by trimming shall be recompact and the area moistened and compacted with one pass of a smooth-wheeled roller. Tolerances shall apply after rolling. Fill slopes shall be trimmed to a uniform alinement at top of berm and reasonably uniform slope at, or outside, the lines shown on the drawings.

### 3.3.3 Compacted Fill, Road

#### 3.3.3.1 Location

Compacted fill, road shall consist of fill placed for the channel maintenance road, in the upper 300 millimeters beneath the road, and of fill placed for the access roadways.

#### 3.3.3.2 Compaction

Fill shall be compacted to not less than 95 percent of maximum density per ASTM D 1557.

### 3.4 BACKFILL

#### 3.4.1 About Structures

##### 3.4.1.1 Location

Backfill about structures shall consist of all fill against and/or around structures, except backfill for pipes and compacted fill.

##### 3.4.1.2 Material

Backfill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, and silty sands. Organic material, silt, clay, broken concrete or pavement, boulders and other unsatisfactory material shall not be used. Backfill for structures shall not contain any stones larger than 75 millimeters.

##### 3.4.1.3 Placing

Backfill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 17.2 megapascals when tested in accordance with Section 03307 CONCRETE FOR MINOR STRUCTURES. Backfill shall be placed in 100 millimeter layers.

##### 3.4.1.4 Compaction

Compaction shall be not less than 90 percent of maximum density, per ASTM D

1557.

### 3.4.2 Initial Backfill

#### 3.4.2.1 Location

Initial backfill shall consist of all fill placed in pipe trench above the bedding and up to a minimum of 610 millimeters above the top of the pipe. The pipe bedding is specified in Section 02400, REINFORCED CONCRETE PIPE, and extends from the bottom of the trench to the springline of the pipe.

#### 3.4.2.2 Material

Material shall conform to the requirement in paragraph: BACKFILL ABOUT STRUCTURES except that the material placed above the springline of the pipe, and until the pipe has a cover of 610 millimeters, shall contain not less than 95 percent by weight passing the 25 millimeters sieve, and shall contain no stone larger than 76 millimeters.

#### 3.4.2.3 Compaction

Compaction shall not be less than 90 percent of maximum density, per ASTM D 1557.

### 3.5 MISCELLANEOUS FILL

Miscellaneous fill shall consist of material from the required excavation, placed in the areas indicated and shall be placed with suitable equipment in layers which shall not exceed 600 millimeters in depth before consolidation. Broken concrete, rock, cemented alluvium, and asphalt to be wasted may be buried in the miscellaneous fill provided such material does not exceed 600 millimeters in its greatest dimension, is placed in a manner that will prevent the formation of voids, and is placed not less than 600 millimeters below finished grade (including finished grade of side slopes).

No depressions in which water might pond shall be left in miscellaneous fill area. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required.

### 3.6 SUBGRADE PREPARATION

Subgrade preparation shall include subgrade preparation for channel slopes and inverts, areas to receive compacted fill, aggregate base course, and junction structures. All trash and debris shall be removed in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS and Section 02200: EXCAVATION.

#### 3.6.1 Channel Subgrade Preparation

After the channel has been excavated to rough grade, the entire subgrade for the channel slopes and invert shall be moisture conditioned and proofrolled by 4 passes of the compaction equipment and trimmed to a uniform grade and smoothed with a steel-wheeled roller to make the subgrade ready to receive filter material and riprap stone. If the subgrade is



disturbed by the Contractor's operations or is overexcavated, or is soft or yielding, the subgrade shall be restored to grade and compacted to a density of 95 percent of maximum density, per ASTM D 1557. The finished surface of the subgrade shall not be more than 25 millimeters from the indicated grade at any point when tested with a 3.1 meter straightedge.

### 3.6.2 Compacted Fill and Aggregate Base Course Subgrade Preparation

The subgrade shall be alternately watered or dried back, and scarified until the material is uniformly moistened throughout for a depth of not less than 150 millimeters to near optimum. All stones larger than 100 millimeters in diameter, and hard ribs of earth shall be removed. The amount of water that is applied shall be that which is required to provide optimum results in compaction under rolling. Following the above operations, the roadbed shall be shaped to a true cross section sufficiently higher than the specified grade to allow for subsequent compaction and then be thoroughly compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. After the subgrade has been prepared and complete, the surface shall be firm, hard, unyielding, with a true, even, and uniform surface conforming to the grade and cross section indicated on the drawings. All points of the finished subgrade shall not be more than 6 millimeters below or above true subgrade.

### 3.7 SOIL STABILIZER

This work shall consist of application of a dust control soil stabilizer to ground surfaces as directed by the Contracting Officer. The work shall include furnishing and applying the stabilizer to the finished grade surfaces that have been disturbed by construction. The dust control treatment does not include dust control measures required due to construction operations.

The soil stabilizing compound shall be readily miscible in water, non-injurious to seed or animal life, non-offensive in odor or handling by humans, non-flammable, and capable of providing surface soil stabilization in various soil classifications without totally inhibiting water infiltration. The soil stabilizing solution shall air cure in 48 hours under normal conditions and have a characteristic of being transparent after drying.

The soil stabilizing vehicle shall be a copolymer emulsion consisting of at least 90% acrylic. The acrylic emulsion shall be disbursed in water. Soil Seal Concentrate as manufactured by Soil Seal Corp., (or approved equal) shall be utilized as the acrylic emulsion.

The soil stabilizing compound shall include the constituent sodium silicate which facilitates the penetration of the compound into the earth, and which assists in creating a crust through the cohesive bonding of the surface soil particles to a depth sufficient to stabilize the soil surface. Further, the compound shall contain an antifoaming agent, allowing said compound to be mixed within a hydraulic applying device without prohibitive foaming. When the compound is mixed with water and applied to the soil, it shall not change the pH factor of the soil more than one (1) pH unit. The compound shall contain a color additive which will assist the

applicator in the uniform application of the product after mixing with water, and which will disappear from the soil surface within 36 hours of application.

The soil stabilizing solution shall be applied in accordance with the manufacturer's instructions. The soil stabilizing compound will be poured into a container with preferably no more than 50% of the water required for its proper mixture already therein. The remainder of the water is then to be added, and the total mixture agitated to insure a completely homogenous final solution.

The soil stabilizing compound shall be added to the water in a quantity so as to be 3 percent of the total quantity of water, shall be applied at a rate to provide coverage of 45 gallons of soils stabilizing compound per acre. The soil stabilizing solution shall be applied evenly in an even spray, the droplets of which should be no smaller than those encountered in a moderate rain storm. All materials shall be delivered to the site in unopened containers, and all containers shall remain tightly closed until used.

Application will not be permitted when weather conditions are unsuitable.

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SECTION 02400

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## SECTION 02400

## REINFORCED CONCRETE PIPE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76M	(1999a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 270	(1999b) Mortar for Unit Masonry
ASTM C 655	(1995a) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06, Instructions

Placing Pipe; GA.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-13 Certificates

Pipeline Testing; GA

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

SD-14 Samples

Pipe for Storm Water Conveyance; GA

Samples of the following materials, before work is started: pipe

### 1.3 DELIVERY, STORAGE, AND HANDLING

#### 1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. The contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

#### 1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

## PART 2 PRODUCTS

### 2.1 PIPE FOR STORM WATER CONVEYANCE

Pipe for storm water conveyance shall be of the sizes indicated and shall conform to the requirements specified. No pipe shall be laid which is cracked, checked, spalled, or damaged, and all such sections of pipe shall be permanently removed from the work at the Contractor's expense. Pipes which show defects due to handling shall be rejected at the site of the installation regardless of prior acceptance at the Contractor's expense.

#### 2.1.1 Reinforced Concrete Pipe

Reinforced Concrete Pipe shall conform to the requirements of ASTM C 76M, Class III, or ASTM C 655 with D-Load of 1,350 pounds per linear foot per foot of pipe diameter to produce a .01 inch crack. The minimum concrete cover over rebar on the inside wall of the pipe shall be 50 mm. Pipe shall have tongue and groove joint designed to be self-centering and to leave a recess on the inside of the pipe for pointing with mortar after joining.

### 2.2 MORTAR

Mortar for pipe joints, connections to other drainage structures, shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be permitted.

### 2.3 ADMIXTURES

Admixtures of hydrated lime, fire clay, diatomaceous earth, or other approved inert material may be used in the mortar to facilitate workability if the Contractor elects. The amount of admixture to be added shall be the quantity determined by the Engineer.

### PART 3 EXECUTION

#### 3.1 EXCAVATION FOR PIPE AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for storm drainage piping shall be in accordance with the applicable portions of Sections 02200 EXCAVATION and 02250 FILLS AND SUBGRADE PREPARATION and the requirements specified below.

##### 3.1.1 Trenching

The width of trenches shall not be greater than required to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe.

##### 3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 150 mm.

##### 3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in Section 3.4. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

#### 3.2 PLACING REINFORCED CONCRETE PIPE

Each pipe section shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

The Contractor shall determine his source of supply of sand for use in mortar a sufficient time in advance of pipe laying operations to permit sampling and testing before use, and no mortar shall be used until the sand has been approved by the Engineer. Pipe sections shall be checked for alignment and grade at the time of joining the sections. If an adjustment in alignment or grade is necessary after making the joint, additional mortar shall be firmly pressed into the joint.

The interior of the pipe shall be kept free of dirt, excess mortar, and other foreign material as the pipe laying progresses, and left clean at the completion of the work. Any pipe which is not in true alignment or which shows any undue settlement after laying, or is damaged, shall be taken up and relaid at the Contractor's expenses. The first section of pipe to be laid shall be firmly placed to the designated line and grade with the groove upstream. Laying shall proceed upgrade with tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Abutting ends of the sections of pipe to be jointed shall then be cleared and wetted, after which joining mortar shall be firmly placed into the lower half of the groove end of the previously laid section. Joining mortar shall be firmly placed on the top half of the tongue end of the section to be jointed which shall then be inserted truly and snugly into the groove end of the section previously laid so as to completely fill the joint. The interior joint shall then be either brushed or pointed and all surplus mortar removed from the pipe. The external space between the ends of the jointed pipe shall be firmly filled from the outside with laying mortar. When pipe with self-centering joints and without an inside pointing recess is furnished, the inside shoulder of the groove end of section shall first be lightly plastered or buttered with joining mortar after which the pipe ends shall be firmly fitted together in such a way that the tongue end of each section fits snugly into the groove end of the preceding section in order to center the joint and form a true flow line. The inside joints shall be troweled or brushed smooth and excess mortar removed from the pipe. The outside joint recesses shall then be filled with mortar, after which backfilling shall be performed as specified. When pipe is furnished with self-centering joints with both inside and outside pointing recesses, the pipe shall be firmly fitted together in such a way that the tongue end of each section fits snugly into the groove end of each preceding section in order to center the joint and to form a true flow line, after which the inside joint recess shall be firmly filled with pointing mortar and then troweled or brushed smooth and excess mortar removed from the pipe, after which backfilling shall be performed as specified. Backfill of the pipe trench may be completed while the joint mortar is still plastic. Should the joint mortar become set before the backfill is placed, backfilling of the trench shall not be commenced within sixteen (16) hours of joining the pipe sections. When the pipe is not backfilled while the mortar is plastic, the mortar shall be cured in accordance with the water, curing compound, form, or waterproof membrane method. Free water shall not be allowed to come in contact with the pipeline until the mortar in the joints has set at least twenty-four (24) hours.

### 3.3 BEDDING

Bedding for all RCP pipe shall be an aggregate base, meeting the requirements of Section 02241 AGGREGATE BASE COURSE. The bedding gradation shall be in accordance with Section 02241 AGGREGATE BASE COURSE.

The bedding shall be placed with a thickness of 150 mm below the pipe and extend up to the springline of the pipe.

The bedding shall be brought up evenly on both sides of pipe for the full length of pipe. The bedding shall be thoroughly compacted under the

haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers in layers not exceeding 100 mm in compacted depth.

### 3.4 BACKFILLING

#### 3.4.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, initial backfill meeting the requirements of Section 02250 FILLS AND SUBGRADE PREPARATION shall be placed along both sides of pipe in layers not exceeding 100 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 610 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 150 mm and compacted to not less than 90 percent of maximum density ASTM D 1557.

#### 3.4.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 610 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 610 mm above the top of the pipe, the remainder of the compacted fill shall be placed and thoroughly compacted in layers not exceeding 300 mm.

### 3.5 TESTING REQUIREMENTS (BACKFILLING)

All testing requirements shall be in accordance with Section 02250 FILLS AND SUBGRADE PREPARATION.

### 3.6 MOVEMENT OF CONSTRUCTION MACHINERY

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

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## SECTION 02600

## STONE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Society for Testing and Materials (ASTM)

ASTM C 33	(1999a) Concrete Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(1998) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(1996) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 1141	(1980) Substitute Ocean Water
ASTM D 5519	(1994) Particle Size Analysis of Natural and Man-Made Riprap Materials
ASTM E 548	(1994) General Criteria Used for Evaluating Laboratory Competence

## PART 2 PRODUCTS

## 2.1 MATERIALS

## 2.2 STONE FOR RIPRAP

## 2.2.1 Definitions

#### 2.2.1.1 Rounded Stone

Stone which is obtained from alluvial deposits and is nearly spherical and well rounded.

#### 2.2.1.2 Angular Stone

Stone which is obtained from bedrock deposits and is angular in shape.

#### 2.2.2 General

The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The Contractor shall vary the quarrying, processing, loading and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications.

#### 2.2.3 Stone Sources

##### 2.2.3.1 Stone From Project Excavation

Stone conforming to these specifications may not be available from the required excavations. The required stone may need to be obtained from offsite sources.

##### 2.2.3.2 Salvaged Stone

Existing stone protection maybe salvaged for channel lining. Salvaged stone which is reused for channel lining shall meet all the requirements of these specifications. Salvaged stone which does not meet the requirements of these specifications shall be disposed of at limits of miscellaneous fill as directed.

##### 2.2.3.3 Source Authorization

Before any stone is produced from a source for completion of the work under this contract, the source of stone must be authorized by the Contracting Officer's Representative. Authorization of a stone source shall not be construed as a waiver of the right of the Government to require the Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, zones or strata will be rejected when such materials do not comply with the specifications.

##### 2.2.3.4 Source Development

Before a proposed source or sources of stone will be considered for sampling and testing, the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements. If sufficient amounts of stone conforming to these specifications are not available from a source or sources used in the work, the Contractor shall submit stone from another source for authorization.

#### 2.2.3.5 Source Documentation

Authorization of a proposed stone source will be based on test results and/or service records. In general, current Corps of Engineers test results shall be required as outlined in paragraph: Quality Compliance Testing, below. In special cases, however, the Contracting Officer's Representative may elect to use either past Corps of Engineers test results, test results from other agencies or private laboratories, or service records. A service record is considered to be acceptable if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to the one to be constructed under these specifications.

#### 2.2.3.6 Potential Stone Sources

The following are a few of the sources in the project area which have either undergone recent quality compliance testing for use on Corps of Engineers projects or have acceptable service records:

Source Name	Location
Hanson Quarry	Henderson, NV
Sloan Quarry	SW of Las Vegas

Listing of a stone source is not to be construed as authorization of all materials from the source, nor as a waiver of inspection and testing of the source. Stone produced from any listed source must meet all the requirements set forth in these specifications. Listing of a stone source is also not to be construed as an indication that the source can produce the total quantity of stone required for the project. Stone may be furnished from other sources designated by the Contractor and authorized by the Contracting Officer's Representative subject to the conditions stated herein.

#### 2.2.4 Stone Quality

##### 2.2.4.1 Quality Compliance Testing

Samples for Corps of Engineers testing as specified in paragraph: Source Documentation shall be submitted a minimum of 45 days in advance of the time when the stone will be required in the work. Stone from a proposed source will be tested by the Government for quality compliance. The first test shall be at Government expense, however, if the stone fails the tests, or if the Contractor desires to utilize more than one source, additional testing will be performed by the Government at the Contractor's expense. The cost of additional testing will be deducted from payment due the Contractor in the amount of \$4500 for each sample tested. All test samples (136 kilograms minimum) shall be representative of the stone source and shall be obtained by the Contractor under the supervision of the

Contracting Officer's Representative and delivered at the Contractor's expense to a testing laboratory specified by the Contracting Officer's Representative. The testing laboratory suggested by the Contractor and specified by the Contracting Officer's Representative shall be under the supervision of a licensed Civil or Geotechnical Engineer or a licensed/registered Geologist.

#### 2.2.4.2 Stone Quality Testing Requirements

Stone shall be subjected to such tests as are necessary to demonstrate to the satisfaction of the Contracting Officer's Representative that the materials are acceptable for use in the work. At a minimum the stone shall meet the following test requirements.

<u>Test</u>	<u>Test Method</u>	<u>Requirement</u>
Specific Gravity (Bulk SSD)	ASTM C 127	2.60 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting and Drying	SPD Test Procedure <sup>(1)</sup>	No fracturing <sup>(3)</sup>
Sulfate Soundness	ASTM C 88 <sup>(2)</sup>	10% max.loss <sup>(4)</sup>
Abrasion Loss	ASTM C 535	50% max.loss <sup>(4)</sup>

In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C 295<sup>(5)</sup>. The stone must not contain any expansive clays. Stone for grouted stone protection shall not contain excessive amounts of deleterious minerals associated with alkali-silica or alkali-carbonate reactions as described in ASTM C 33.

NOTE: (1): Test procedure for wetting and drying test. The entire sample is carefully examined and representative test specimens are selected. The sample should be large enough to produce two cut slabs, 25 mm thick (+/-5 mm) with a minimum surface area of 19,600 square mm on one side. Two chunks approximately 76 by 100 mm are also chosen. The slabs and chunks are carefully examined under a low-power microscope and all visible surface features are noted and recorded. The specimens are then oven dried at 140 degrees F., for eight hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 140 degrees F. After each cycle the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all particles broken off during the test are oven dried, weighed and photographed.

NOTE: (2): The test shall be made on 50 particles each weighing 100 grams, +/-25 grams, in lieu of the gradation given in ASTM C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.

NOTE: (4): Stone which has a loss greater than the specified limit will be accepted if the Contractor demonstrates that the stone has a satisfactory service record.

NOTE: (5): The test procedure for Petrographic and X-ray Diffraction is performed according to ASTM C 295, except for the following:

(a) A color, microscopic photograph shall be made of each stone type and the individual minerals within the stone shall be identified by labels and arrows upon the photograph.

(b) A very detailed macroscopic and microscopic description shall be made of the stone, to include the entire mineral constituents, individual sizes, their approximate percentages and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall also be discussed.

(c) A written summary of the suitability of stone for use as riprap based on the Petrographic and X-ray tests and the results of ASTM C 535 shall be presented in the final laboratory report on stone quality.

#### 2.2.4.3 Stone Acceptance Criteria

Prior to placement, all stone shall be subject to acceptance by the Contracting Officer's Representative. Acceptance of any stone shall not constitute acceptance of all stone from a source. All accepted stone shall be:

- a. of the same lithology as the original stone from which test results or service records were taken as a basis for authorization of the source;
- b. sound, durable and hard, and free from laminations, weak cleavages, undesirable weathering, or blasting or handling-induced fractures (or fracture zones which subtend more than 1/3 of the total circumference of the stone along the plane of fracturing);
- c. of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing; and,
- d. clean and free from earth, clay, refuse, or adherent coatings.

#### 2.2.4.4 Riprap Stone

Riprap stone shall be angular quarried material with a shape which assures interlocking with adjacent stone, and with the greatest dimension of each piece not greater than 3 times the least dimension.

## 2.2.5 Gradation

### 2.2.5.1 General

All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading due to segregation or degradation during placement shall be rejected. If test results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

### 2.2.5.2 Riprap Stone Gradation

Riprap shall be quarried, angular stone reasonably well-graded within the limits specified below, when tested in accordance with ASTM D 5519, Test Method A.

Approximate Average Diameter (mm)	Percent Passing (by weight)
460	100
330	60-100
230	15-55
180	0-25
130	0

### 2.2.5.3 Gradation Sampling and Testing

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Tests shall be performed by an approved testing laboratory on samples selected by the Contracting Officer's Representative. Testing may be done by the Contractor, subject to approval by the Contracting Officer's Representative. If the Contractor elects to establish testing facilities, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted, until the Contractor's facilities have been inspected and approved by the Contracting Officer's Representative. Testing shall be supervised by a registered Civil Engineer, experienced in rock-testing. The Government reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. One gradation test shall be required at the beginning of production prior to delivery of stone from the source to the project site. A minimum of one additional test shall be required for each 1000 tonnes of stone placed. Each sample shall consist of not less than



2(two) tonnes of stone, selected at random from the production run for the first test or from stone placed on grade or stockpiled on-site for required additional tests. All sampling and gradation tests performed by the Contractor shall be under the supervision of the Contracting Officer's Representative.

#### 2.2.6 Rejected Stone

Stone of unsuitable quality and/or size distribution as required by these specifications shall be rejected. Any rejected stone shall be promptly removed from the project at no expense to the Government. Any portions of the work covered by these specifications containing rejected stone will be considered incomplete.

### 2.3 FILTER MATERIAL

#### 2.3.1 Gradation

General gradation criteria contained in Paragraph 2.2.5.1 in this SECTION shall also apply to filter material.

Filter material shall be durable, hard, tough, and free from adherent coatings. The material shall not contain corrosive agents, organic matter, or soft, friable, thin or elongated particles in quantities considered deleterious by the Contracting Officer. Filter material shall consist of gravel or crushed stone and shall show a loss in weight of not more than 50 percent when tested in accordance with ASTM C 131, and shall be reasonably well graded within the following limits:

Sieve Size (millimeters)	Percent by Weight Passing
63.5	100
50.8	90-100
38.1	35-70
25.4	0-15
12.7	0-5

#### 2.3.2 Gradation Sampling and Testing for Filter Material

Sampling and testing shall be in accordance with ASTM C 136. Testing shall be required once at the beginning of production, prior to the delivery of material from the source to the project site. A minimum of one additional test shall be required for each 500 tonnes of material placed.

## PART 3 EXECUTION

### 3.1 FOUNDATION PREPARATION

#### 3.1.1 General

Subgrade preparation for material placement shall conform to the provisions of Section 02250 FILLS AND SUBGRADE PREPARATION. Areas on which filter material is to be placed shall be trimmed and dressed to conform to cross sections indicated or directed, within an allowable tolerance of plus or

minus 25 mm from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth similar to the adjacent material and well compacted, or by filling with approved material, and no additional payment will be made for any material thus required. Immediately prior to placing the filter material and prior to placing the stone, the prepared surface shall be inspected by the Contracting Officer's Representative and no material shall be placed thereon until that area has been approved.

### 3.2 PLACEMENT

#### 3.2.1 General

Except as otherwise specified, the limits of stone in place shall follow, with reasonable variation, the indicated lines and slopes, without continuous under- or overbuilding. Templates shall be placed at adequate intervals, as determined by the Contracting Officer's Representative, to accurately delineate the surface of the work being placed. For all stonework, the Contractor shall submit the method of placement to the Contracting Officer's Representative for approval, before placement begins.

#### 3.2.2 Riprap

Riprap shall be placed in a manner to produce a reasonably well-graded mass with the minimum practicable percentage of voids, and shall be constructed to the lines and grades indicated or directed. Stone shall be placed to its full course thickness in one operation from the bottom of the slope to the top of the slope and in a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 460 mm.

#### 3.2.3 Method of Placement

Method of placement shall be submitted to Contracting Officer's Representative for approval prior to commencement of placement operations. The Contractor shall maintain the stone protection until accepted and any material displaced by any cause shall be replaced at his expense to the lines and grades shown on the drawings. Self propelled equipment shall not be used on the channel slopes. Hand placing, barring, or placing by crane will be required only to the extent necessary to secure the results specified. Placing stone by dumping into chutes or by similar methods likely to cause segregation will not be permitted. A tolerance of minus 25 to plus 76 mm from the indicated slope lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 20 square meters.

### 3.3 DEMONSTRATION SECTION

#### 3.3.1 General

Prior to placement of stonework, the Contractor shall construct a section including invert and both sides of the channel, consisting of riprap to demonstrate his proposed operations for production placement. The section shall demonstrate procedure and capability of grading, placing stone protection within the tolerances specified. The demonstration section

shall be 30 meters in length and shall conform to all applicable specifications. Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of riprap stone and shall conform with the requirements specified herein. The quantities of all materials placed within the section shall be accurately tabulated and provided immediately to the Contracting Officer's Representative for comparison with the computed quantities.

#### 3.3.2 Demonstration Section Evaluation

The Contractor shall not proceed placing stonework prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Contracting Officer's Representative shall determine the adequacy of the section to function as part of the permanent construction. The Contractor shall be notified as to the acceptability of the section and may be directed to modify methods of construction, and remove the section if necessary.

#### 3.3.3 Removal of Demonstration Section

If removal of the demonstration section is required, it shall be conducted in such a manner as to maintain the integrity of the underlying subgrade. The Contractor shall make his own arrangements for disposal in areas not located on the site.

### 3.4 DELIVERY

All stone delivered shall be weighed and the scale tickets certified by authorized weighers. All trucks used for delivering stone shall be plainly numbered.

#### 3.4.1 Scales

The Contractor may use his own scales or public scales. Weighing shall be at the point nearest the work at which the public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling the material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau charged with scales inspection within the state in which the project is located. Scales shall be calibrated and resealed as often as necessary to insure continuous accuracy. The necessary number of standard weights for testing the scales shall be on hand at all times and, if an official inspection bureau of the state is not available, the scales will be tested by the Contracting Officer's Representative.

#### 3.4.2 Waybills and Delivery Tickets

Copies of waybills or delivery tickets shall be submitted to the Contracting Officer's Representative during the progress of the work. The Contractor shall furnish the Contracting Officer's Representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, date, time, and location of the loading. Tickets shall be furnished at the point and time

individual loads arrive at the work site. A master log of all vehicle loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer's Representative the master log of loadings, certified waybills and/or certified tickets within 24 hours of material delivery. Prior to the final payment, the Contractor shall furnish written certification that the material recorded on the submitted waybills and/or certified tickets was actually used in the construction covered by the contract.

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SECTION 02831

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## SECTION 02831

## CHAIN LINK FENCE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(1998) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 270	(1999b) Mortar for Unit Masonry
ASTM C 476	(1999) Grout for Masonry
ASTM F 626	(1996a) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1999) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL

## PROCEDURES:

SD-13 Certificates  
Chain Link Fence; GA

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

## PART 2 PRODUCTS

## 2.1 FENCE FABRIC

Fence fabric shall conform to the following:

## 2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 610 grams of zinc per square meter of coated surface. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh or Type I, aluminum-coated fabric. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

## 2.2 POSTS

## 2.2.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B shall meet the strength and coating requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal corner, gate, and pull posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

## 2.3 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043.

## 2.4 WIRE

## 2.4.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

## 2.5 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge

steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

## 2.6 CONCRETE

ASTM C 94/C 94M, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## 2.7 TEMPORARY FENCING

Temporary fencing shall be orange in color, shall consist of a 4-foot high, high-density polyethylene fencing, installed where indicated or required. Mortar and grout to set posts in holes shall conform to ASTM C 270, Type M and ASTM C 476.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3 m. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

## 3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 50 mm clearance between the bottom of the fabric and finish grade.

## 3.3 POST INSTALLATION

### 3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25 mm greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post,



shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts.

#### 3.4 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m. A center brace or 2 diagonal truss rods shall be installed on 3.66 m fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

#### 3.5 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 102 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

#### 3.6 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 610 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the ground.

#### 3.7 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed at all gate locations. Slide gates shall be installed as recommended by the manufacturer. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

#### 3.8 TEMPORARY FENCING INSTALLATION

Temporary fencing shall be installed in accordance with manufacturer's recommendations. Posts shall be set plumb in holes formed in the ground and grouted into place. Grout shall be thoroughly consolidated around each post so as to be free of voids and finished in a dome. The Contractor shall maintain the fencing throughout the life of the project. Fencing shall be removed, including posts and grout and holes filled with compacted

fill, at the end of the contract.

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## SECTION 03307

## CONCRETE FOR MINOR STRUCTURES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 308	(1992; R 1997) Standard Practice for Curing Concrete
ACI 318M	(1995) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 347R	(1994) Guide to Formwork for Concrete

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1998) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999a) Concrete Aggregates
ASTM C 39/C 39M	(1999) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 143/C 143M	(1998) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds

for Curing Concrete

ASTM C 494/C 494M	(1999a) Chemical Admixtures for Concrete
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 685	(1998a) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1997) Sampling Aggregates

CORPS OF ENGINEERS (COE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
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## 1.2 DESIGN AND PERFORMANCE REQUIREMENTS

The Government will maintain the option to sample and test joint sealer, joint filler material, aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143/C 143M and ASTM C 231, respectively, when cylinders are molded. Compression test specimens will be made, cured, and transported in accordance with ASTM C 31/C 31M. Compression test specimens will be tested in accordance with ASTM C 39/C 39M. Samples for strength tests will be taken not less than once each shift in which concrete is produced. A minimum of three specimens will be made from each sample; two will be tested at 28 days for acceptance, and one will be tested at 7 days for information.

### 1.2.1 Strength

Acceptance test results will be the average strengths of two specimens tested at 28 days. The strength of the concrete will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength,  $f'_c$ , and no individual acceptance test result falls below  $f'_c$  by more than 3.4 MPa.

### 1.2.2 Construction Tolerances

A Class "C" finish shall apply to other exposed surfaces. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The surface requirements for the classes of finish required shall be as specified in ACI 347R. A class "A" or "B" finish shall be required for vertical exposed surfaces of headwalls. A class "A" shall be required for walls inside junction structures.

#### 1.2.3 Concrete Mixture Proportions

Concrete mixture proportions shall be the responsibility of the Contractor.

Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. The maximum water cement ratio shall be 0.45. The minimum specified compressive strength  $f'_c$  shall be 30 MPa at 28 days. The maximum nominal size coarse aggregate shall be 37.5 mm, in accordance with ACI 318M. The air content shall be between 4.5 and 7.5 percent. The slump shall be between 50 and 125 mm.

#### 1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-09 Reports

Concrete Mixture Proportions; FIO.

Ten days prior to placement of concrete, the contractor shall submit the mixture proportions that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

Aggregates; FIO.

Aggregates will be accepted on the basis of certificates of compliance and test reports that show the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

##### SD-13 Certificates

Cementitious Materials; FIO.

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Cementitious material will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material(s) meet the requirements of the specification under which it is furnished.

## SD-01 Data

Air-Entraining Admixture; FIO.

Accelerating Admixtures; FIO.

Water-Reducing or Retarding Admixture; FIO.

Reinforcing Steel; FIO.

Curing Materials; FIO.

Manufacturer's literature is available from suppliers which demonstrates compliance with applicable specifications for the above materials.

Batching and Mixing Equipment; FIO.

Batching and mixing equipment will be accepted on the basis of manufacturer's data which demonstrates compliance with the applicable specifications.

Conveying and Placing Concrete; FIO.

The methods and equipment for transporting, handling, depositing, and consolidating the concrete shall be submitted prior to the first concrete placement.

## SD-08 Statements

Formwork; FIO.

Formwork design shall be submitted prior to the first concrete placement.

## PART 2 PRODUCTS

## 2.1 MATERIALS

## 2.1.1 Nonshrink Grout

Descriptive literature of the nonshrink grout proposed for use shall be furnished together with a certificate from the manufacturer stating that is suitable for the application for which it is being considered.

## 2.1.1.1 Portland Cement

ASTM C 150, Type V, low alkali.

## 2.1.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618, Class F, with loss on ignition limited to 6 percent.



### 2.1.2 Aggregates

Aggregates shall meet the quality and grading requirements of ASTM C 33, Class Designations 4M or better and shall be shown to be non-reactive nor contain any deleterious substances.

### 2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Admixtures shall not contain chlorides. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the contractor at the request of the Contracting Officer and shall be rejected if test results are not satisfactory.

#### 2.1.3.1 Air-Entraining Admixture

Air-entraining admixture shall meet the requirements of ASTM C 260.

#### 2.1.3.2 Accelerating Admixture

Accelerating admixtures shall meet the requirements of ASTM C 494/C 494M, Type C.

#### 2.1.3.3 Water-Reducing or Retarding Admixture

Water-reducing or retarding admixture shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D.

### 2.1.4 Water

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

### 2.1.5 Reinforcing Steel

Reinforcing steel bar shall conform to the requirements of ASTM A 615/A 615M, Grade 420. Details of reinforcement not shown shall be in accordance with ACI 318M, Chapters 7 and 12.

### 2.1.6 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond-breaker material shall be polyethylene tape, coated paper, metal foil, or similar type materials. The backup material shall be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

#### 2.1.7 Formwork

The design and engineering of the formwork as well as its construction, shall be the responsibility of the Contractor.

#### 2.1.8 Form Coatings

Forms for exposed surfaces shall be coated with a nonstaining form oil, which shall be applied shortly before concrete is placed.

#### 2.1.9 Epoxy Resin

Epoxy resin for use in repairs shall conform to ASTM C 881, Type III, Grade I or II.

#### 2.1.10 Curing Materials

Curing materials shall conform to the following requirements.

##### 2.1.10.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

##### 2.1.10.2 Membrane-Forming Curing Compound

ASTM C 309, Type 2.

##### 2.1.10.3 Nonshrink Grout

Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the application proposed. Grout strength shall be 30 MPa in 3 days.

### PART 3 EXECUTION

#### 3.1 PREPARATION

##### 3.1.1 General

Construction joints shall be prepared to expose coarse aggregate, and the surface shall be clean, damp, and free of laitance. Ramps and walkways, as necessary, shall be constructed to allow safe and expeditious access for concrete and workmen. Snow, ice, standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Earth foundations shall be satisfactorily compacted. Spare vibrators shall be available. The entire preparation shall be accepted by the Government prior to placing.

##### 3.1.2 Embedded Items

Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Internal ties shall be arranged so that when the forms are removed all metal will be not less than 50 mm

from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

### 3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. All exposed joints and edges shall be chamfered, unless otherwise indicated.

### 3.1.4 Production of Concrete

#### 3.1.4.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M except as otherwise specified.

#### 3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685.

#### 3.1.4.3 Batching and Mixing Equipment

The contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. The method of measuring materials, batching operation, and mixer shall be submitted for review. On-site plant shall conform to the requirements of either ASTM C 94/C 94M or ASTM C 685.

### 3.1.5 Nonshrink Grout Application

Nonshrink grout shall conform to the requirements of paragraph NONSHRINK GROUT. Water content shall be the minimum that will provide a flowable mixture and fill the space to be grouted without segregation, bleeding, or reduction of strength. Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified.

## 3.2 CONVEYING AND PLACING CONCRETE

Conveying and placing concrete shall conform to the following requirements.

### 3.2.1 General

Concrete placement shall not be permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours

or 45 minutes when the placing temperature is 30 degrees C or greater unless a retarding admixture is used. Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 450 mm or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

#### 3.2.2 Consolidation

Each layer of concrete shall be consolidated by internal vibrating equipment. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 100 mm. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the layer below, if such a layer exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly at the rate of about 75 mm per second.

#### 3.2.3 Cold-Weather Requirements

No concrete placement shall be made when the ambient temperature is below 2 degrees C or if the ambient temperature is below 5 degrees C and falling. Suitable covering and other means as approved shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Salt, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing. Any concrete damaged by freezing shall be removed and replaced at the expense of the contractor.

#### 3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI 308, is expected to exceed 1 kilogram per square meter per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

### 3.3 FORM REMOVAL

Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

### 3.4 FINISHING

#### 3.4.1 Chamfer

All exposed corners shall have 20 mm chamfer.

#### 3.4.2 Finishing Formed Surfaces

All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 13 mm in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

#### 3.4.3 Finishing Unformed Surfaces

All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 10 mm for a float finish as determined by a 3 m straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during finishing.

##### 3.4.3.1 Float Finish

Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

##### 3.4.3.2 Broom Finish

A broom finish shall be applied to slabs on grade. The concrete shall be screeded and floated to required finish plane with no coarse aggregate visible. After surface moisture disappears, the surface shall be broomed or brushed with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed.

### 3.5 CURING AND PROTECTION

Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:

- a. Continuous sprinkling or ponding.
- b. Application of absorptive mats or fabrics kept continuously wet.
- c. Application of sand kept continuously wet.
- d. Application of impervious sheet material conforming to ASTM C 171.
- e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 2 shall be accomplished in accordance with manufacturer's instructions.

The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7. If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 15 degrees C within a 24 hour period.

### 3.6 TESTS AND INSPECTIONS

#### 3.6.1 General

The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

#### 3.6.2 Inspection Details and Frequency of Testing

##### 3.6.2.1 Preparations for Placing

Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

##### 3.6.2.2 Air Content

Air content shall be checked at least twice during each shift that concrete is placed for each concrete mix design delivered. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231.

#### 3.6.2.3 Slump

Slump shall be checked twice during each shift that concrete is produced for each concrete mix design delivered. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

#### 3.6.2.4 Consolidation and Protection

The Contractor shall ensure that the concrete is properly consolidated, finished, protected, and cured.

#### 3.6.3 Action Required

##### 3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators, which are in working order and have competent operators, are available. Placing shall not be continued if any pile is inadequately consolidated.

##### 3.6.3.2 Air Content

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment shall be made to the dosage of the air-entrainment admixture.

##### 3.6.3.3 Slump

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

#### 3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered within 3 days after the end of each weekly reporting period. See Section 01440 CONTRACTOR QUALITY CONTROL.

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## SECTION 05500

## MISCELLANEOUS METAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 276	(1998b) Stainless Steel Bars and Shapes
ASTM A 320/A 320M	(1999) Alloy Steel Bolting Materials for Low-Temperature Service
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM B 32	(1996) Solder Metal
ASTM B 221	(1996) Aluminum - Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
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## ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

## COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1925 (Rev A; Notice 1) Shield, Expansion (Nail Anchor)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings  
Miscellaneous Metal Items; GA

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: other miscellaneous metalwork.

## 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

## PART 2 PRODUCTS

## 2.1 MATERIALS

## 2.1.1 General

Materials indicated on the drawings or required in the work and not covered elsewhere by detailed requirements shall conform to the requirements of this section. In all cases not specifically covered in these specifications, the Contractor shall furnish approved highest grade commercial materials or products which are suitable for the intended use of the item.

## 2.1.2 Structural Shapes and Plates

Steel bars, shapes and plates shall conform to ASTM A 36/A 36M. Galvanized coatings where required, shall conform to ASTM A 123/A 123M.

### 2.1.3 Wall Ladders Rungs (Galvanized)

Manhole steps shall conform to ASTM C 478M and C 497. Aluminum steps shall be solid made from material in conformance with ASTM B 221 (Alloy 6005-TS).

Reinforced plastic steps shall be polypropylene plastic coated 10 mm deformed steel rod per ASTM A 36/A 36M. All steps shall be epoxied in place during the installation process.

### 2.1.4 Steel Pipes

Steel pipe, including inserts in concrete, shall be hot-dipped (galvanized) steel pipe conforming to the requirements of ASTM A 53/A 53M, Standard Weight, Schedule 40.

### 2.1.5 Corrosion-Resisting Steel Bolts and Anchor Bolts

Corrosion-resisting steel bolts and anchor bolts shall conform to ASTM A 276, Class 304, Condition A, or the applicable requirements of ASTM A 320/A 320M, Grade B8.

### 2.1.6 Bolts

Bolts shall conform to ASME B18.2.1. Corrosion resisting bolts shall conform to ASTM A 276, Class 304, Condition A, or the applicable requirements of ASTM A 320/A 320M, Grade B8. The turned eye bolt shall have a 19 mm eye size, leg length of 100 mm and at least 3 mm thick.

### 2.1.7 Nuts

Nuts shall conform to ASME B18.2.2. Nuts shall be galvanized.

### 2.1.8 Expansion Anchors

Expansion anchors shall conform to the applicable requirements of CID A-A-1925. Anchors shall be multiple unit with inside thread.

### 2.1.9 Concrete, Mortar and Grout

Concrete, mortar and grout shall conform to the requirements of Section 03307 CONCRETE FOR MINOR STRUCTURES.

### 2.1.10 Pipe Safety Railing

Safety railing shall be designed to resist a concentrated load of 90 kg in any direction at any point of the top of the rail or 30 kg/m applied horizontally to top of the rail, whichever is more severe.

#### 2.1.10.1 Steel Safety Railing, Including Carbon Steel Inserts

Steel safety railing, including inserts in concrete, shall be steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railing shall be 2 inch nominal size. The completed assembly shall be hot-dip galvanized, after

fabrication.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, weld and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

(3) Railing may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

#### 2.1.11 Trash Rack

Fabricate as shown; galvanize after fabrication.

### PART 3 EXECUTION

#### 3.1 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Steel with welds will not be accepted, except where welding is definitely specified or called for on the drawings. All bolts, nuts, and screws shall be tight. Work shall be accurately set to established lines and elevations and securely fastened in place. Anchorage shall be provided where necessary for fastening miscellaneous metal and wood items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; machine and carriage bolts for steel; and lag bolts and screws for wood.

#### 3.2 FINISHING

In general, tolerances for machine-finished surfaces designated by nondecimal dimensions shall be within 0.4 mm. Sufficient machining stock shall be allowed on placing pads to insure true surfaces of solid material.

Finished contacts of bearing surfaces shall be true and exact to secure full contact. All drilled holes for bolts shall be accurately located and drilled from templates.

#### 3.3 ZINC COATING (GALVANIZING)

Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123/A 123M. All exposed ferrous metalwork, except

cast-iron and corrosion resistant steel and items to be completely embedded in concrete, shall be galvanized unless other protective coatings are specified. Metalwork shall be galvanized after fabrication. In the event that any portion of galvanized metalwork is abraded or otherwise damaged to the extent that the base metal is exposed, such damaged or abraded portions shall be neatly covered with Grade 50B solder conforming to the requirements of ASTM B 32.

### 3.4 WELDING

Welding shall conform to the provisions of AWS D1.1. Welders who have not been certified within two years of the date of commencement of work under this contract will not be allowed to perform the work.

### 3.5 BOLTED CONNECTIONS

Bolt holes shall be reamed normal to the member and shall be truly cylindrical throughout. Unless otherwise specified, holes for bolts shall not be more than 1.60 mm larger than the diameter of the bolt. Cutting bolt holes with a torch will not be permitted without the prior written approval of the Contracting Officer. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable.

### 3.6 EXCAVATION

Excavation for concrete-embedded items shall be of the dimensions indicated on the drawings. Holes shall be cleared of loose materials prior to placement of concrete.

### 3.7 PIPE SAFETY RAILING

Pipe Safety Railing shall be fabricated with galvanized steel pipe and shall be fabricated in the shop. Care shall be taken to deform pipe without A breaking at the steel. Any pipe deformations that demonstrate visible cracking or weakening may be cause for rejection. The pipe gate components shall be galvanized. Welded, cut, damaged, and deformed areas of galvanizing metal shall be neatly coated with Grade 50B solder conforming to ASTM B 32. The Contractor shall examine and certify the operation of all safety pipe railing not sooner than 30 days after installation.

#### 3.7.1 Attachment of Safety Railing

Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

#### 3.7.2 Installation of Pipe Safety Railing

Installation shall be in pipe sleeves embedded in concrete and filled with non-shrink grout with anchorage covered with standard pipe collar pinned to post. Rail ends shall be secured by steel pipe flanges.

-- End of Section --